Updates on reconstruction

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Slide from collaboration meeting talk

Selected longest track produced by each particle

	K$^+$	μ$^+$	e$^+$
LineCluster+PMA	57.2%	90.8%	76.9%
TrajCluster+PMA	64.9%	85.3%	85.8%
Pandora	39.2%	79.1%	4%*

*Pandora tends to reconstruct electron as a shower-like pfparticle, not a track

- TrajCluster improves the tracking efficiency for K$^+$ and e$^+$, need to improve tracking efficiency for muons.

- Pandora were not tuned for this topology, efficiencies are shown only for reference.

Updates since then

- I was surprised the muon tracking efficiency was only 85% with TrajCluster.

  - It turned out I made a mistake when I implemented the new functions to improve cluster reconstruction - very technical, because I was unfamiliar with code.

  - Bruce helped me fix the problem - call the function in the right place.

- Bruce keeps making improvements to the TrajCluster code.

  - One new feature is that now TrajCluster matches clusters in 3 views and create PFParticles, which can be fed to PMA to create tracks.
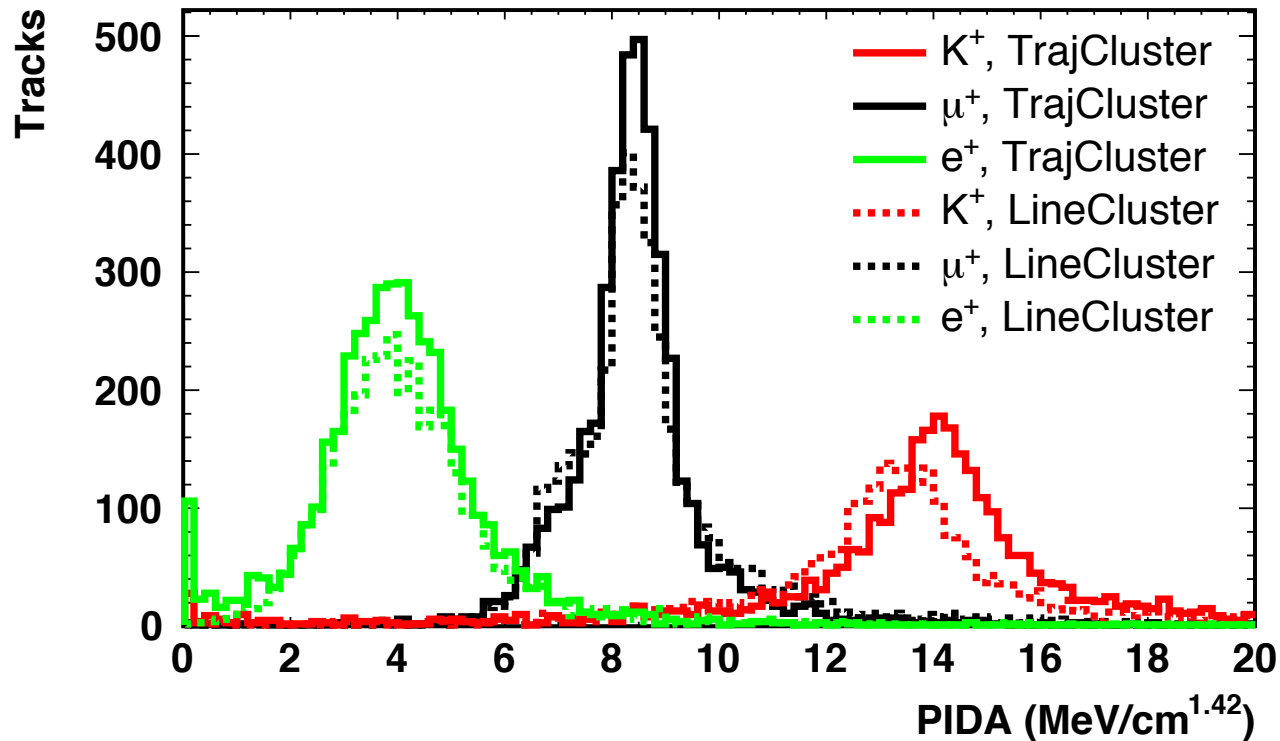
Configuration	TrajCluster	PMA
Mode 1	2D clustering	3D matching + track fitting
Mode 2	2D clustering + 3D matching	track fitting

DUNE

New efficiencies

|	K$^+$	μ$^+$	e$^+$
LineCluster+PMA	57.2%	90.8%	76.9%
TrajCluster+PMA (before bug fix)	64.9%	85.3%	85.8%
TrajCluster+PMA (after bug fix)	**71.8%**	**93.9%**	**94.5%**
TrajClusterPFP	**69.4%**	**97.6%**	**90.0%**

- After the bug fix, track efficiency is improved for all 3 particles.

- The new configuration using TrajCluster PFParticles gives interesting results: higher efficiency for muons and lower efficiency for K$^+$/e$^+$.

PIDA

The figure shows a histogram of Tracks versus PIDA (MeV/cm$^{1.42}$), with the following legend:
- K$^+$, TrajCluster (red, solid)
- μ$^+$, TrajCluster (black, solid)
- e$^+$, TrajCluster (green, solid)
- K$^+$, LineCluster (red, dotted)
- μ$^+$, LineCluster (black, dotted)
- e$^+$, LineCluster (green, dotted)

- New reconstruction gives better results: more reconstructed tracks, narrower distributions.

- K$^+$ PIDA distribution is shifted slightly to higher values, protons included in the track?

Inefficiency in muon reconstruction
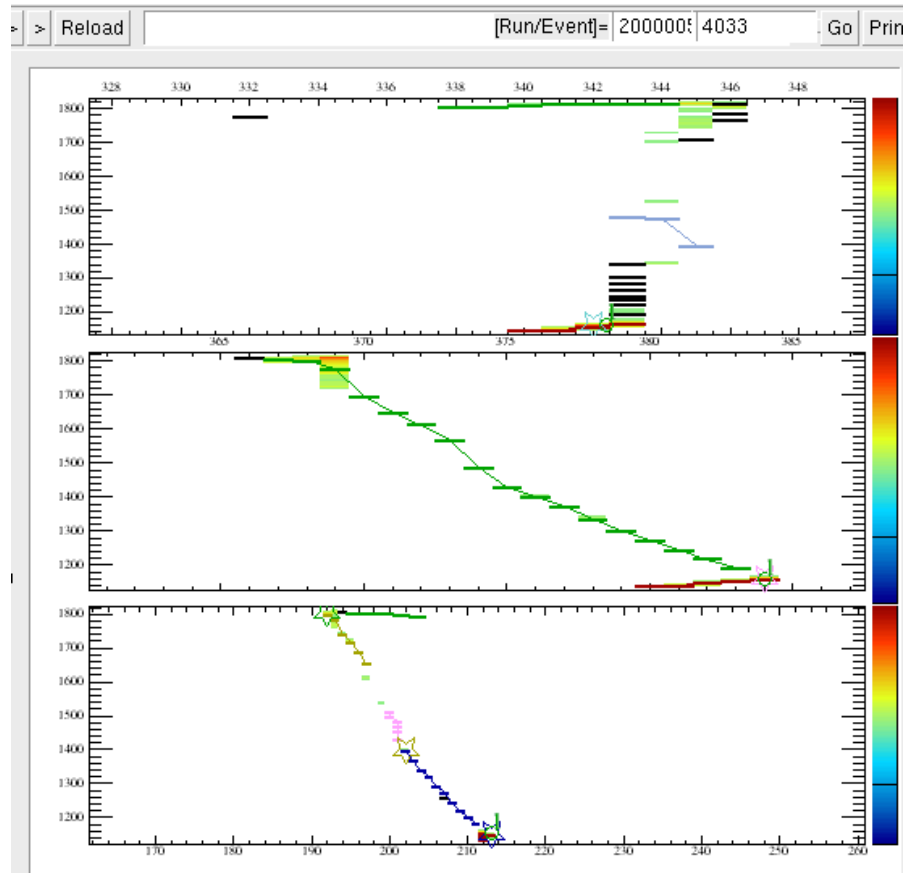
- Muon track almost goes perpendicular to the wire planes - hitting the limit of LArTPC.

- Need special treatment of hit/cluster reconstruction.

Future plan

- Continue to improve reconstruction

  - Special knobs have been created to improve reconstruction of kaon events - tuning still needed.

  - May try to improve reconstruction of difficult events - perpendicular to wire planes (not critical).

  - Time scale - a few weeks.

- Freeze reconstruction, help Aaron with analysis

  - Try new ideas.

  - Use all available information, kaon/muon/electron length, dE/dx, charge ratio, PD information, MVA analysis, etc.

  - May have to go back to fix/improve things in reconstruction.

- Available for TF report? - not sure, improved reconstruction may help current analysis

- Goal is to delivery the best results we can get for the TDR

  - Time scale - two years